

International Standards enabling Printed Electronics for Wearables

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Abstract

This paper serves as an introduction to the standardization effort taking place to support the industrialization of Wearable Electronic Devices and where Printing for Fabrication technologies will fit into these. It commences with a short overview of the market sectors for Wearable Electronic Devices and examine where Printed Electronics and other technologies will contribute. In this way it will show where the interest in Printing for Fabrication currently lies, concentrating in particular on textile electronics and sensor fabrication.

It explains the concept of e-textiles in this space and by describing the structure and organization of IEC TC 124 it charts the route whereby interested parties can participate. This way it shows some of the benefits that can be gained by participation and lists some of the groups that a participant would expect to meet. It finishes by listing at some of the challenges that need to be met by future standardization activities.

Introduction

The topics of Printed Electronics and Wearable Electronic Devices illustrates well how industrialization of a technology and the development of International Standards should proceed in parallel. Although the 2 markets have evolved in disparate manners and over different timescales these are now coming together as Printing for Fabrication could become an enabling technology for both.

International Standards for Wearable Electronics Devices are now being actively worked on within 2 IEC Technical Committees relevant to Printing for Fabrication. The first is the well-established IEC TC 119 (Printed Electronics) and the second a relatively new standards committee, IEC TC 124 (Wearable electronic devices and technologies). The purpose of this paper is to summarize the work that is now taking place within these groups with an emphasis on the areas relevant to Printing for Fabrication.

Market sectors for Wearable Electronic Devices

A number of market sectors for Wearable Electronic Devices are outlined in the Strategic Business Plan for IEC TC 124 [1]. These are illustrated in Figure 1 and enables us to examine where Printing for Fabrication technologies will fit into these.

This figure is useful in that it guides us to where the interest in Printing for Fabrication will be, concentrating in particular on textile electronics and sensor fabrication. Electronic textiles (e-textiles) figures strongly in most of these sectors, as does printed sensors. Printing for Fabrication looks set to be a key technology in the future of Wearable Electronic Devices as the market transitions from hard devices in plastic to flexible and conformable electronics.

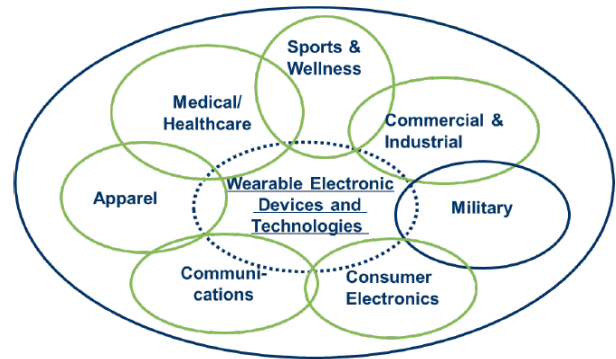


Figure 1 Wearable Electronics Market sectors from the Strategic Business Plan of IEC TC 124

It should be noted that while it may be an attractive sector for Printing for Fabrication the standardization of medical wearables could be fraught due to the complexity of the landscape and regulatory environment. As an example, medical device standardization proceeds in a very different manner and regime to consumer electronics.

Relevant Printed Electronics standardization

Standardization in the field of Printed Electronics takes place within IEC TC 119 and has been summarized at a past meeting of this conference [2]. Some of the work packages within IEC TC 119 have particular relevance to Wearable Electronic Devices and these are summarized here. An additional view of the work of IEC TC 119 will be given in a separate paper at this conference [3].

This work within IEC TC 119 continues and of particular relevance here is the work to standardize test methods for flexible and stretchable inks and substrates. Already published is a technical report on the materials needed for printed electronics in wearable electronic devices [4].

In the area of printed sensors IEC TC 119 is working on test methods and procedures for product parameters, lifetime assessment and reliability testing of printed flexible gas sensors.

International Standards for Wearable Electronic Devices

There are a number of groups active within the field of standardization of wearable electronics. Chief among these is the relatively new IEC TC 124; Wearable electronic devices and technologies [5]. This is a truly international effort and has started work in areas that currently focus on textile electronics and sensors, well aligned with the technologies of Printed Electronics.

The internationally agreed scope of IEC TC 124 includes the following areas of wearable electronic devices: -

- patchable materials and devices
- electronic textile materials and devices.

Both of these areas are particularly of relevance to the Printing for Fabrication community.

Activity within IEC TC 124

The activity currently taking place within IEC TC 124 is best summarized by Figure 2 which can also be taken as a reflection of the international interest in the development of wearable devices.

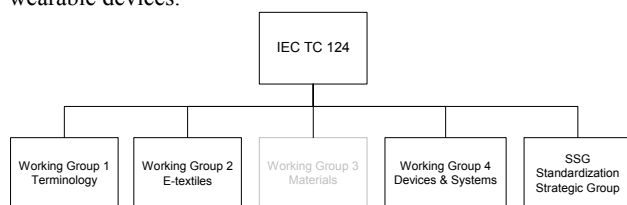


Figure 2 The structure of IEC TC 124

Working Group 1 – Terminology is active and is working on a standard with the working title “Wearable electronic devices and technologies – Part 101-1: Terminology”. This is an important work item for Printing for Fabrication as we need to establish a common understanding of terminology to bring both towards industrialization.

Working Group 2 – e-textiles is an area that is of particular relevance to the Printing for Fabrication community. It is also an area of common interest with IEC TC 119 as printing has a significant role in the fabrication of e-textile systems. E-textiles can be seen to be an emerging area between electronics adapted for textiles and textiles adapted for electronics. This concept was developed by the study group that led to the formation of IEC TC 124 and is summarized in Figure 3.

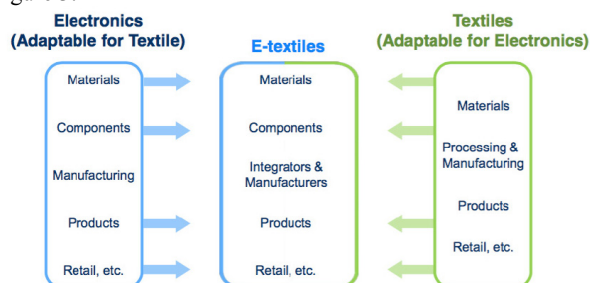


Figure 3 The concept of e-textiles from IEC Study Group 10

The current work item within WG2 is “Wearable electronic devices and technologies – Part 204-1: Washability test method for leisure and sportswear e-textile system” and indications are that more work items will follow within 2018.

IEC TC 124 plans to have a working group on materials specific to wearable electronic devices. This has a placeholder label of WG3 but as there are currently no formal work items in place this group is currently not active.

Working Group 4 – devices and systems already has a number of work items under the “Wearable electronic devices and technologies – Part 20X-1” banner: -

- Part 401-1: Evaluation method of the stretchable resistive strain sensor
- Part 402-1: Test and evaluation methods for wearable glove sensors

- Part 406-1: Low temperature skin burn safety test methods for band type on-body wearable electronic devices

The sensor work that is likely to figure strongly in the work of WG4 will be of significant interest to the Printing for Fabrication community.

Finally, the Standardization Strategic Group will guide the strategy and technical roadmap for IEC TC 124.

Benefits from participation

A significant community is coming together at the meetings of both IEC TC 119 (Printed Electronics) and IEC TC 124 (Wearable electronic devices and technologies). The communities have much in common and in October 2018 will have co-located Plenaries at the IEC General Meeting in Busan, KR. Both groups attract delegates from across the globe and particularly from Asian nations so form a useful network across this broad applications area.

One further benefit that is particularly useful are the other standards committees that work with these Technical Committees to achieve a common goal. As a result, participation in either IEC TC 119 for Printed Electronics or IEC TC 124 for Wearable Electronic Devices can bring a perspective on an area from multiple directions. As an example, IEC TC 124 works with groups setting International Standards in textiles, IoT, medical devices, displays and printed electronics.

Other groups active in standardization for Wearables

Due to the breadth and interest in wearable technologies this space is becoming complicated by multiple entrants. However, it is worth bringing a number of groups to the attention of the Printing for Fabrication community.

The optics & photonics community

Future wearable electronics devices look likely to figure significant optics and photonics as well as electronics. The fabrication of at least part of these assemblies onto flexible substrates could well be an area for printing. IEC TC 124 is now working with IEC TC 110 (Electronic display devices) and ISO TC 172 (Optics and Photonics) so is a good portal to become aware of work in this area.

Bioelectronics

There is some work of significance going on within the bioelectronics community that is relevant to wearable electronic devices. Bioelectronics is a challenging field because of the multidisciplinary nature of the work but relevant collaborations are emerging. One within the University of Manchester has taken note of the role of the role of printing in this space to print graphene based wearable electronic components [6].

Organic Electronics Association (OE-A)

The OE-A has taken a keen interest in standardization in these areas. The topic of device encapsulation is one current area where an OE-A group is having dialogue with IEC TC 119 for printed electronics. This is likely to be a challenging area for wearable devices so this may continue with IEC TC 124 in the future.

There is already ongoing discussion between IEC TC 119 and the OE-A on keeping the roadmaps for the 2 organizations congruent. Given the overlap between printed electronics and

wearable electronic devices this input is a likely scenario for IEC TC 124 in the future.

Future standardization activity

Surface roughness issues are likely to figure highly in future work as this is of particular relevance to textiles. Some background work on this has already been done on roughness of surfaces and the effect on device fabrication using Printed Electronics [7]. Examples building on this were later illustrated at this conference [8].

There is also the looming issues of data privacy and security. Confidentiality is likely to be a significant issue with biomedical data and while it is not of direct relevance to Printing for Fabrication technologies it should be kept in mind for any future program.

Conclusions

International Standardization work in the field of Wearable Electronic Devices has started within IEC TC 124. Printing for Fabrication technologies have a role to play in future wearable electronic devices and IEC TC 124 could provide a useful contact into a wider international and technical community.

For those with a specific focus on Printed Electronics IEC TC 119 will provide a similar network.

References

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Author Biography

Alan has 35 years experience across the printing industry and has been involved in printed electronics for over 10 years, first in materials and later as a practitioner. He remains active in Printed Electronics as Chair of the International Standards committee IEC TC 119.

He is a past President of the IS&T and a long-term member of the conference committee for Printing for Fabrication. He is now active in the field of wearable electronics as an industrial consultant, as Head of the UK delegation to IEC TC 124 and as a Visiting Academic to the Centre for Digital Fabrication, University of Manchester, UK.